

Claims

- [c1] 1.A method for processing fault log data from a machine comprising a plurality of respective pieces of equipment, the method further processing operational parameter data indicative of operational and/or environmental conditions for the respective pieces of equipment, the method comprising:
- collecting fault log data comprising a plurality of faults from any malfunctioning piece of equipment;
 - collecting operational parameter data relatable to each respective time of occurrence of the plurality of faults from the malfunctioning equipment;
 - identifying a plurality of distinct faults in the fault log data;
 - identifying a plurality of data buckets indicative of respective levels of quantization of each operational parameter;
 - generating at least one distinct fault cluster from the plurality of distinct faults;
 - relating to each generated fault cluster a respective quantization level of at least one operational parameter to provide at least one fault cluster configurable in at least one of the following cluster configurations: a stand-alone fault cluster configuration and a cluster configuration enhanced with quantized operational parameter data;
 - generating a plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data;
 - and
 - identifying at least one repair for the at least one fault cluster enhanced with quantized operational parameter data using the plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data.
- [c2] 2.The method of claim 1 wherein each data bucket is configured to capture and distinguish statistically-measurable influences on the performance of a given piece of equipment based on the quantization level of each respective operational parameter.
- [c3] 3.The method of claim 1 wherein each of the plurality of weighted repair and distinct fault cluster combinations is generated from a plurality of cases, each

case comprising a repair and at least one distinct fault enhanceable with quantized operational parameter data.

[c4] 4. The method of claim 3 further comprising determining a respective weight for each of the plurality of weighted repair and distinct fault cluster combinations enhanced with quantized operational parameter data.

[c5] 5. The method of claim 4 wherein said weight is determined by:
counting the number of times a respective fault cluster combination with quantized operational parameter data sharing a common quantization level for at least one operational parameter occurs in cases comprising related repairs;
counting the total number of times the combination with the common quantization level occurs in said plurality of cases; and
computing the ratio of the counted number of times the combination occurs in cases comprising related repairs over the counted number of times the combination occurs in the plurality of cases.

[c6] 6. The method of claim 1 wherein the operational parameter data comprises a plurality of snapshot observations of operational parameters from the pieces of equipment.

[c7] 7. The method of claim 6 wherein the respective snapshot observations of operational parameters from the machine and the logging of respective faults from the machine are temporally aligned relative to one another.

[c8] 8. The method of claim 1 wherein the operational parameter data comprises a plurality of continuous observations of operational parameters from the machine.

[c9] 9. The method of claim 6 wherein the respective continuous observations of operational parameters from the machine and the logging of respective faults from the machine are temporally co-relatable to one another.

[c10] 10. A method for processing fault log data from a machine comprising a plurality of respective pieces of equipment, the method further processing

operational parameter data indicative of operational and/or environmental conditions for the respective pieces of equipment, the method comprising:

collecting fault log data comprising a plurality of faults from any malfunctioning piece of equipment;

collecting operational parameter data relatable to each respective time of occurrence of the plurality of faults from the malfunctioning equipment;

identifying a plurality of distinct faults in the fault log data;

identifying a plurality of data buckets indicative of respective levels of quantization of each operational parameter, wherein each data bucket is configured to distinguish measurable influences on the performance of a given piece of equipment based on to the quantization level of each operational parameter;

generating at least one distinct fault cluster from the plurality of distinct faults;

relating to each generated fault cluster a respective quantization level of at least one operational parameter to provide at least one fault cluster configurable in at least one of the following cluster configurations: a stand-alone fault cluster configuration and a cluster configurations enhanced with quantized operational parameter data;

predicting at least one repair for the at least one fault cluster using a plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data.

[c11] 11.The method of claim 10 wherein each of the plurality of weighted repair and distinct fault cluster combinations is generated from a plurality of cases, each case comprising a repair and at least one distinct fault enhanced with quantized operational parameter data.

[c12] 12.The method of claim 11 wherein each of the plurality of weighted repair and distinct fault cluster combinations is assigned a weight, wherein said weight is determined by dividing the number of times a respective fault cluster combination sharing a common quantization level for at least one operational parameter occurs in cases comprising related repairs by the total number of times that combination occurs in said plurality of cases.

[c13] 13.A system for processing fault log data from a machine comprising a plurality of respective pieces of equipment, the system further processing operational parameter data indicative of operational and/or environmental conditions for the respective pieces of equipment, the system comprising:

- a database for collecting fault log data comprising a plurality of faults from any malfunctioning piece of equipment;
- a database for collecting operational parameter data relatable to each respective time of occurrence of the plurality of faults from the malfunctioning equipment;
- a processor configured to identify a plurality of distinct faults in the fault log data;
- a processor configured to identify a plurality of data buckets indicative of respective levels of quantization of each operational parameter;
- a processor configured to generate at least one distinct fault cluster from the plurality of distinct faults;
- a processor configured to relate to each generated fault cluster a respective quantization level of at least one operational parameter to provide at least one fault cluster configurable in at least one of the following cluster configurations: a stand-alone fault cluster configuration and a cluster configuration enhanced with quantized operational parameter data;
- a processor configured to generate a plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data; and
- a processor configured to identify at least one repair for the at least one fault cluster using the plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data.

[c14] 14.The system of claim 13 wherein each data bucket is configured to capture and distinguish statistically-measurable influences on the performance of a given piece of equipment based on the quantization level of each respective operational parameter.

[c15] 15.The system of claim 13 wherein each of the plurality of weighted repair and distinct fault cluster combinations is generated from a plurality of cases, each case comprising a repair and at least one distinct fault enhanceable with quantized operational parameter data.

[c16] 16. The system of claim 15 further comprising a processor configured to determine a respective weight for each of the plurality of weighted repair and distinct fault cluster combinations enhanced with quantized operational parameter data.

[c17] 17.The system of claim 16 wherein said weight is determined by dividing the number of times a respective fault cluster combination with quantized operational parameter data sharing a common quantization level for at least operational parameter occurs in cases comprising related repairs by the total number of times the combination with the common quantization level occurs in said plurality of cases.

[c18] 18.The system of claim 13 wherein the operational parameter data comprises a plurality of snapshot observations of operational parameters from the pieces of equipment.

[c19] 19.The system of claim 18 wherein the respective snapshot observations of operational parameters from the machine and the logging of respective faults from the machine are temporally aligned relative to one another.

[c20] 20.The system of claim 13 wherein the operational parameter data comprises a plurality of continuous observations of operational parameters from the machine.

[c21] 21.The system of claim 18 wherein the respective continuous observations of operational parameters from the machine and the logging of respective faults from the machine are temporally co-relatable to one another.

[c22] 22.An article of manufacturing comprising:
a computer-readable medium including computer-readable program code for causing a computer to process fault log data from a machine

comprising a plurality of respective pieces of equipment, the computer-readable program code further causing the computer to process operational parameter data indicative of operational and/or environmental conditions for the respective pieces of equipment, the computer-readable program code in said article of manufacturing comprising:

computer-readable program code configurable to collect fault log data comprising a plurality of faults from any malfunctioning piece of equipment;

computer-readable program code configurable to collect operational parameter data relatable to each respective time of occurrence of the plurality of faults from the malfunctioning equipment;

computer-readable program code configurable to identify a plurality of distinct faults in the fault log data;

computer-readable program code configurable to identify a plurality of data buckets indicative of respective levels of quantization of each operational parameter, wherein each data bucket is configurable to distinguish measurable influences on the performance of a given piece of equipment based on to the quantization level of each operational parameter;

computer-readable program code configurable to generate at least one distinct fault cluster from the plurality of distinct faults;

computer-readable program code configurable to relate to each generated fault cluster a respective quantization level of at least one operational parameter to provide at least one fault cluster configurable in at least one of the following cluster configurations: a stand-alone fault cluster configuration and a cluster configuration enhanced with quantized operational parameter data; and

computer-readable program code configurable to predict at least one repair for the at least one fault cluster using a plurality of weighted repair and distinct fault cluster combinations enhanceable with quantized operational parameter data.

[c23] 23.The article of manufacturing of claim 22 wherein each of the plurality of weighted repair and distinct fault cluster combinations is generated from a plurality of cases, each case comprising a repair and at least one distinct fault enhanceable with quantized operational parameter data.

[c24] 24.The article of manufacturing of claim 23 wherein each of the plurality of weighted repair and distinct fault cluster combinations enhanced with quantized operational parameter data is assigned a weight, wherein said weight is determined by dividing the number of times the combination occurs in cases comprising related repairs by the total number of times a respective fault cluster combination sharing a common quantization level occurs in said plurality of cases.